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NOTES ON TRISETUM AND GRAPHEPHORUM.

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The limitations of the larger genera of the tribe *Aveneae* are in no case clearly defined, and the classification of many of the species will always be determined with more or less doubt, resting finally upon the judgment of the agrostologist, rather than upon any definite characters. Some of the smaller genera in the tribe are established upon purely technical or artificial characters subject to more or less individual variation, and at best of questionable taxonomic value. Such are *Aira*, *Graphephorum*, and *Ventenata*, while one has only to consult the synonymy of the species of *Avena*, *Deschampsia* and *Trisetum* to discover how varied have been the views concerning them, species resting for a time in one genus only to be shifted by a later author to another, until some have figured for a season in three or even more recognized genera. Botanists have repeatedly attempted to fix upon characters which would sharply outline a genus, and in some cases have sought to attain this result by establishing new genera. *Deschampsia*, *Danthonia* and *Trisetum* were thus segregated from *Aira* and *Avena*, but with the advancement of our knowledge through the investigation of more abundant material and discovery of "new" species, the generic limits have been broken here and there until we are forced to admit the futility of the attempt, accepting the fact that the different groups or divisions of organic life even to the ultimate specific units, however natural they may appear, present variations which, in one way or another, so connect them together that they present a unity of development wherein genera and species become simply the expressions of the scientist, merely serving to facilitate his efforts in studying the grand scheme of nature.

Specific characters, or those used to define species, are no less variable than the generic, and it is the purpose of this paper to call attention to some of these in a few of our native grasses concerning whose classification there has been some diversity of opinion. A brief discussion of the genera included is necessary to the presentation of the subject.

TRISETUM.— Persoon, in 1805, segregated from *Avena* a number of species upon which he founded the genus *Trisetum* with the following characters: "*Cal.* 2–3-florus, acuminatus, carinatus. *Cor.* aristis 2 terminalibus subdentiformibus (glum. apice setoso-bifidis), 1 dorsali recta nec contorta, flosc. ut plurimum glabris. (*Spiculae* compressae, pallescentes.)"[1] The bidentate flowering glumes straight, not twisted, dorsal awns and compressed spikelets were apparently the differential characters. Persoon evidently had some doubts as to the limitations of his genus, for he concludes his enumeration of the species by the observation: "Nonnullae generis *Avenae* species ex. gr. Av. pensylvanica, lupulina et purpurea huc quoque pertinere videntur, quae ulterius examen hinc merentur." *Trisetum palustre* he leaves in *Avena*. Eleven species make up the genus, six of which are now referred to other genera; one, the first described, to *Ventenata*; two to *Danthonia*; and three to *Avena*. The fourth species described, *T. nitidum* Pers., is still retained in the genus, and being the first species for which a figure is cited, must be accepted, according to the opinion of some taxonomists, as the type of the genus.

Seven years later, in 1812, Beauvois[2] takes up *Trisetum*, increasing the number of species to eighteen, only half of which, according to the Kew Index, are now retained in the genus; *Ventenata*, *Danthonia*, *Aira*, and *Avena* claiming seven while two are merely synonyms. It may be of interest to note here that the *Trisetum subspicatum* is the *Aira subspicata* of Linnaeus[3] but was published six years earlier by the same author under *Aira spicata* (Linn. Sp. Pl. **1**: 64. 1753),[4] the name taken up by Richter in 1890 (Richt. Pl. Eu. **1**: 59.) Beauvois apparently had a very clear conception of the genus as it is understood today, and his failure to apply properly his diagnosis, shown by his rather heterogeneous assemblage of species, only seems to

[1] Pers. Syn. **1**: 97. 1805.
[2] Agros. 88, Pl. 18, fig. 1.
[3] Syst. Nat. ed. 10. **2**: 873. 1759.
[4] *Aira spicata* on page 63 of Species Plantarum was changed by Linnaeus in the errata to *Aira indica*.

emphasize the fact already noted, that the element of opinion or judgment plays no small part in the deductions of the keenest observers. That Beauvois was an acute observer of rare judgment his work amply shows, and his diagnosis of *Trisetum*, here quoted, presents all the essential characters embodied in the more pretentious efforts of recent authors. "Axis paniculatus: Panicula composita.— Glumae membranaceae, 3–5-florae, longitudine flosculorum: Palea infer. *biseta, dorso supra medium aristata*: *Arista herbacea, flexuosa, raro plicata.*" He separates *Danthonia* and *Avena* from *Trisetum* by the character of the awn, which in these genera he describes as being plicate and twisted, while *Deschampsia* has the apex of the flowering glume multidentate, with the slender awn inserted near its base. He makes no mention of the relationship of the genus with *Eatonia*, *Koeleria*, or *Deyeuxia*, and fails to recognize the genus *Ventenata*, published by Koeler (Desc. Gram. 272, 1802).

Beauvois separates *Graphephorum* chiefly by the shortness of the awn: "paleae bifido-dentatae: infer. inter dentes mucronata." Hairiness of the rachilla is common to most species of *Trisetum*, and there are both North and South American species in which the awns are very short or even suppressed entirely. Desvaux (Gay, Flor. Chil. **6**: 352, 1853) forms a section in the genus, Sect. *Koeleria*, to include the species in which the awns are straight, usually short, or sometimes wanting. He includes in this section *Trisetum micratherum* and *T. subaristatum*. Grisebach (In Abhandl. Gesellsch. Wiss. Goett. **24**: 292, 1879) transfers *T. micratherum* Desv. to *Koeleria*. I have seen the grass referred by Philippi (Ann. Univ. Chil. **43**: 568, 1873) to this species, and would retain it in *Trisetum*. It is distinguished from *Koeleria* by its decidedly unequal empty glumes, bearded callus and rachilla, and short subterminal awns. The texture and character of the glumes are like those of *T. Wolfii* Vasey, and the inflorescence is much the same as in that species. Philippi (Ann. Univ. Chil. **94**: 26, 1896) refers his *Trisetum minutiflorum* to the same section—(*Koeleriae*), but this grass is not referable to *Trisetum*. It belongs to the section *Lophochloa* of *Koeleria*, being most closely allied to *K. phleoides* and *K. villosa* Pers.

Trinius (Fund. Agros. 157, 1820.) unites *Trisetum* with *Avena*, but later (Mém. Acad. St. Pétersb. VI, **1**: 59, 1830) he takes up the genus and in his diagnosis describes the flowering glume as "bidentate vel bisubulate, dorso arista vel infra apicem setigera (rarissime mutica)."

He divides the genus into three sections; those species having "perianthiis bidentatis, aristis (setis) abbreviatis" form his section "b," to which he refers *Koeleria villosa* and *K. phleoides* Pers. The third section, which is established with a query, has the flowering glumes awnless. Here he includes *Eatonia obtusata* (Mx.) A. Gray and *E. pennsylvanica* (D.C.) A. Gray, with the remark that the latter is similar to *Trisetum palustre*. It is clear that Trinius recognized the close relationship of *Eatonia* and *Koeleria* with *Trisetum* by uniting these genera with it, although he apparently excluded them a few years later when he published (Mém. Acad. St. Pétersb. VI. **4**[2]: 10–11, 1836) a more complete diagnosis of the genus, evidently the result of much careful study. He does not appear to have made any reference to *Graphephorum melicoideum*, at least I have failed to discover any, but this grass would certainly fall under *Trisetum* as above characterized.

GRAPHEPHORUM:— In a memoir upon some new genera of Gramineae published in 1810 (Nov. Bull. Soc. Philom. de Paris, II. **2**: 189) Desvaux established the genus *Graphephorum* upon Michaux's *Aira melicoides*, published in 1803 (Flor. Bor. Am. **1**: 62). Michaux describes his plant as follows:

"A. erecta, glabra, planifolia: panicula parvula, subracematim coarctata: gluma communi partialibusque majusculis, lineari-lanceolatis, muticis; his basi villis cinctis: minutissimo tertii flosculi rudimento pedicellato.

"Obs. Ex secundi flosculi basi nascitur pedicellus longiusculus, villosus, vix perceptibili floris rudimento terminatus.

"Hab. Canada."

Desvaux evidently examined specimens of the grass, probably Michaux's, for he adds some characters in his diagnosis not noted by the author of the species.

"*Graphephorum*. Gluma biflora valvulae acutae integerrimae; glumellae inclusae; valvulae bifidae, appendix interflorus, elongatus, pilosus, pilis secundis. Spiculae paniculatae.

"Graphephorum melicoideum Desv.

"Aira melicoides Michx.

"L'appendice qui characterise ce genre, ne ressemble point à une fleur avortée, c'est un corps tout particulier."

He does not compare *Graphephorum* with *Trisetum*, but separates it from *Aira* by the peculiar character of the prolongation of the

rachilla, which he makes the essential character of his new genus, placing it with *Triodia*.

Beauvois in 1812 recognizes *Graphephorum*, and adds a little to the generic characters without increasing the number of species. He says (Agros. 76): "Flosc. suprem. pedicellato, abortivo, villosissimo.—Paleae bifido-dentatae: infer. inter dentes mucronata." He evidently looked upon the hairy prolongation of the rachilla as an aborted floret, and his specimens showed the minute awn below the teeth of the flowering glume, which character was not manifest in the material examined by Michaux and Desvaux, or was overlooked by them, but which is nevertheless common, the awn often being quite conspicuous.

In 1856, Dr. Asa Gray published (Man. ed. **2**: 556) as new a form of *Aira melicoides* Mich. under the genus *Dupontia*, naming it *D. Cooleyi* and comparing it with *Aira caespitosa* and *Aira bothnica*. Later, having discovered the relation of his grass with Michaux's *Aira melicoides*, *Graphephorum melicoideum* of Desvaux, he revised the genus *Graphephorum* (Annal. Bot. Soc. Canada, **1**[1]: 55–57, 1861) modifying its characters so as to include the species of *Scolochloa*, *Dupontia*, and *Colpodium*, reducing his *Dupontia Cooleyi* to a variety of *Graphephorum melicoides*, characterizing it as "a luxuriant form from 2 to 3 feet high with ampler panicles."

There is in the Gray Herbarium a specimen collected by Dr. Cooley in Macomb Co., Michigan, which is doubtless the type of this variety, and in its robust habit and pilose leaves, Gray very naturally failed at first to connect it with the more slender and glabrous plant described by Michaux. This specimen has scabrous leaves which are pilose upon the upper surface, spikelets 6–7 mm. long, unequal empty glumes, the broad 3-nerved second glume nearly equalling the spikelet and the oblong obtuse flowering glumes, which are entirely awnless. The rather stiff hairs on the rachilla are about 1.5 mm. long. This variety is exactly represented in the National Herbarium by 26,222 *J. Macoun*, from Johnston's Harbor, Lake Huron, collected in 1901.

Both Hackel (Engl. & Pr. Naturl. Pflanzenf. **2**[2]: 74, 1887) and Baillon (Hist. d. Plant. **12**: 212, 1894) hold *Graphephorum* as a genus distinct from *Dupontia*, *Scolochloa*, and *Colpodium*; but regard it as being closely allied to them, placing it with them in the *Festuceae*. This disposition appears to be wholly unwarranted, for there is nothing in common between *Graphephorum* and the genera above named excepting the hairiness about the base of the flowering glume, while there

are striking features suggesting relationship with the *Aveneae* as indicated by the earlier authors. The habit of the plant, the character of the inflorescence, the texture and nervation of the glumes, the inequality and length of the outer ones, the hairiness of the rachilla, and the occasional presence of an awn below the apex of the floral glumes all point to a close relationship with *Trisetum*. The entire absence of the awn in the specimens first described has been the stumbling block apparently, leading various authors to erroneous conclusions. As already noted, the reduction of the awn in length sometimes to a mere mucronate point or even its entire suppression is not uncommon among the *Aveneae*. In *Avena*, the cultivated oat is often awnless; the awns are very variable in *Deschampsia caespitosa*; in *Trisetum filifolia* Scribn. the awns are very short (less than 1 mm.), while in *T. filifolium pubescens* they are well developed (3–4 mm.); *T. muticum* (Thurb.) Scribn. has both short-awned and awnless spikelets; while in *T. montanum* Vasey short-awned forms also occur.

At the Philadelphia meeting of the A. A. A. S. in 1884, Dr. Vasey presented a paper in which he pointed out the close relationship of *Eatonia* with *Trisetum*, concluding with the statement "that *Eatonia* and *Erisetum* are very closely related, and should both be in the section *Avenaceae*, as also should some species of the genus *Graphephorum*." (Bot. Gaz. **9**: 167. 1884) The species of *Graphephorum* referred to by Dr. Vasey were *G. melicoideum* Desv. and *G. Wolfii* Vasey. The relationship of these with *Trisetum* was discussed by the present writer at the same meeting, and published in connection with Dr. Vasey's communication. (Bot. Gaz. l. c. figs. 4–5) The writer here says, quoting a letter from Dr. Vasey: "*Graphephorum melicoides* should be *Trisetum melicoides*; or if a genus (*Graphephorum*) be made for it, it should come next to *Trisetum* or *Avena*, for it is evidently Avenaceous." Here we have the first definite reference of *Graphephorum melicoideum* to *Trisetum*. More recent investigations and present very careful study of the entire subject, aided by the ample material in the National Herbarium, have only served to establish more firmly the conclusions set forth by Dr. Vasey.

TRISETUM MELICOIDEUM (Michx.) Vasey, Bot. Gaz. **9**: 169, 1894; *Aira melicoides* Michx. Flor. Bor. Am. **1**: 62, 1803; *Graphephorum melicoideum* Desv. Nouv. Bull. Soc. Philom. **2**: 189, 1810; Beauv. Agrost. 76, *Pl. 15, fig. 8*, 1812; Scribn. U. S. Dept. Agr. Div. Agros. Bul. 20, fig. 121, 1900.

A slender glabrous perennial, with flat leaves and open nodding panicles 10–12 cm. long. Spikelets 2–3-flowered, about 6 mm. long, with unequal empty glumes, the broader 3-nerved second glumes about equalling the florets; flowering glumes narrow, oblong, obtuse or imperfectly 2-lobed or 2-toothed, awnless or with a very short awn just below the apex (see figures above cited); paleae about ¼ shorter than the glume, hyaline; callus and joints of the rachilla hairy, the hairs on the rachilla, at least the upper ones, 1.5 to 2 mm. long.

Specimens examined: Mt. Kineo, Maine, *C. E. & A. H. Smith*, 1868; St. Anne des Monts River, Quebec, *O. D. Allen*, 1881; Madeleine River, Quebec, *J. Macoun*, 1882.

Trisetum melicoideum Cooleyi (Gray) Scribn. n. comb.; *Dupontia Cooleyi* A. Gray, Man. ed. **2**: 556, 1856; *Graphephorum melicoides major* A. Gray, Annals Bot. Soc. Can. **1**:[1] 57, 1861; *G. melicoides Cooleyi* Scribn. Mem. Torr. Bot. Club, **5**: 53, 1894.

Lower sheaths pubescent, upper surface of the leaves pilose; flowering glumes 5–6 mm. long, minutely punctate-scabrous, entire at the acute apex, awnless. Otherwise as in the species.

Specimens in the National Herbarium: Orion, Michigan, no. 882, *O. A. Farwell*, 1895; Flint, Michigan, *D. Clark*; Winooski River, Vermont, *C. G. Pringle*, 1877; St. Francis, Maine, no. 187, *M. L. Fernald*, 1893; Western Vermont, no. 1753, *L. R. Jones*, 1899; Gault, Ontario, no. 54, *Wm. Harriot*, 1901; Canada, no. 131, *J. Macoun*, 1871. Shores Lake Huron, Canada, no. 26,222, *J. Macoun*, 1901; Rocky Banks, Lake Huron, *Macoun*, July, 1874.

In the specimen last mentioned the spikelets are 3- to 4-flowered and 9 mm. long; the callus hairs 1–2 mm. long, soft and lax.

A glabrous form from Vermont, collected by Mr. C. G. Pringle in 1876, connects the variety with the species. It has the elongated lower leaves and entire flowering glumes in which the midnerve is sometimes excurrent just below the minutely toothed apex.

Trisetum Wolfii Vasey, Monthly Report U. S. Dept. Agr. Mar. 156, 1874; Bot. Wheeler Expedition **7**: 294, *Pl. 27, fig. 1, 2, 3*, 1878; *Graphephorum Wolfii* Vasey in Coulter Man. Rocky Mt. Bot. 423, 1885.

A rather slender caespitose perennial, with glabrous culms, flat leaves, and contracted usually densely flowered panicles 10 to 20 cm. long. Sheaths and leaves glabrous or pubescent, varying to pilose. Spikelets 2–3-flowered, 5–7 mm. long, slightly compressed; empty glumes subequal in length, broadly lanceolate, acute, scabrous on the

keel above, the first 1-nerved, the second a little broader and 3-nerved; flowering glumes oblong, minutely erose, dentate at the rounded or imperfectly 2-lobed apex, the first 5 to 6 mm. long, awned on the back a little below the apex or awnless. Palea nearly as long as the glume. Callus and rachilla bearded, hairs short. Awn when present rarely extending beyond the apex of the glume, but varying in length from .5 to 3.0 mm.

Colorado, Idaho, Washington, Oregon, and California. Type locality, Twin Lakes, Colorado.

The typical form of this species, which does not extend west of the Rocky Mountains, is glabrous throughout. It is represented in the National Herbarium by the following specimens: COLORADO, no. 693, *Geo. Vasey*, 1868; no. 668, *Hall & Harbour*, 1873; no. 333, *F. E. Clements*, 1896; no. 180, *C. F. Baker*, 1899; no. 1063, *C. L. Shear*, 1896; nos. 1449, 1482, *Shear & Bessey*, 1898; WYOMING, nos. 4013, 4012, *Aven Nelson*, 1897; no. 455, *E. Nelson*, 1901; no. 2617, *T. A. Williams*, 1897; no. 7787, *Aven Nelson*, 1900. MONTANA, no. 493, *C. L. Shear*, 1905; UTAH, no. 4292, *Pammel & Backwood*, 1902.

Trisetum Wolfii muticum (Thurb.) Scribner, n. comb.

Trisetum subspicatum muticum Thurb. in Brew. & S. Wats. Bot. Calif. **2**: 296, 1880; *T. muticum* Scribn. U. S. Dept. Agr. Div. Agros. Bul. **11**: 50, *fig. 10*, 1898.

Sheaths pubescent, often quite densely so, with downwardly directed hairs, leaves pubescent or pilose only upon the upper surface. CALIFORNIA, no. 5019, *Bolander*, 1866; OREGON, no. 1314, *W. C. Cusick*, 1886; no. 2333, *Cusick*, 1899; no. 147, *Griffiths & Hunter*, 1902; WASHINGTON, no. 949, *W. N. Suksdorf*, 1889; no. 101, *Suksdorf*, 1884; MONTANA, no. 370, *F. Lamson-Scribner*, 1883; no. 573, *R. S. Williams*, 1890; no. 3080, *P. A. Rydberg*, 1896; IDAHO, no. 435, *Heller, Sandberg & McDougal*, 1892; no. 1049, *J. B. Leiberg*, 1895, panicles unusually lax; no. 2812, *C. V. Piper*, 1898 (specimen in Gray Herb.).

Specimens with the lower sheaths finely scabro-pubescent occur throughout the range of the species, connecting the pubescent with the glabrous forms.

The spikelets of *T. Wolfii* are less compressed and the glumes are somewhat firmer in texture than in *T. spicatum molle*, from any form of which it is readily separated by its subequal empty glumes. This latter character, together with the narrower, elongated and densely flowered panicles, at once distinguish *Trisetum Wolfii* from any form

of *T. melicoideum*. From the more nearly allied **Trisetum altijugum** Scribn. n. comb. (*Graphephorum altijugum* Fourn.) by its larger panicles and spikelets which are about 4 mm. long. The panicle of *T. altijugum* resembles that of *Sporobolus indicus*.

TRISETUM MONTANUM Vasey, Bull. Torr. Bot. Club, *13*: 118, 1886; *T. alpestre* Vasey, Bot. Wheeler Exped. **6**: 294, *Pl. 27, fig. 4, 5, 6*, 1878—not *T. alpestre* Beauv. 1812; *Trisetum Shearii* Scribn. U. S. Dept. Agr. Div. Agros. Circ. **30**: 8, 1901; *Graphephorum Shearii* Rydb. Bull. Torr. Bot. Club, **32**: 602, 1905.

Dr. Vasey at first referred this grass to the European *Trisetum alpestre*; later he noted its close relationship with *T. flavescens*, and he says (MS. notes in National Herbarium): "much like *T. flavescens*, but wanting in the color; the leaves are much longer, the spikelets are smaller, the flowering glumes much more acuminate, the awns shorter and less twisted." The specimens of the Wheeler Expedition (no. 669, *J. Wolfe*) are about 2.5 dm. high, with rather densely flowered panicles 6–8 cm. long. Robust specimens 6–10 dm. high, with more open panicles 10 to 20 cm. long, are represented in the National Herbarium from Idaho Falls, no. 720, *C. L. Shear*, and nos. 2481, 2484, 2491, *P. A. Rydberg*, 1895. It is difficult to separate these from *T. flavescens*, the most obvious difference being in the awn, which is straight or simply divergent in *T. montanum*, while in *T. flavescens* it is twisted below and distinctly geniculate. The glumes, especially the flowering ones, are a very little broader in the last named species.

The lower sheaths and leaves vary from being entirely glabrous to pilose or pubescent, as in no. 2479, *P. A. Rydberg*, and no. 718, *C. L. Shear*, 1895, both from Idaho Springs. Other specimens with the lowermost sheaths pubescent come from Las Vegas, New Mexico, collected by *G. R. Vasey*, and from Garland, Colorado, no. 71, *C. L. Shear*, 1900. Variations in the length of the awn occurs in this as in other species of *Trisetum*, and the color varies from pale silvery green to purplish shades, the shortening of the awn occurring in the latter, being especially manifest in no. 1214, *C. L. Shear*, from Silverton, Colorado, specimens that were at first regarded as representing a distinct species (*T. Shearii* Scribn.). Other specimens showing intermediate characters occur connecting the short-awned forms with the longer awned types.

The distribution of *Trisetum montanum* appears to be limited to the mountain regions of Colorado and New Mexico.

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